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GEOMORPHIC LANDSCAPES*

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In his presidential address delivered before the Association of American Geographers at the Madison meeting in December, 1948, our foremost physical geographer, Richard Joel Russell, chose to discuss the relationship of geomorphology to geography. Noticing the steady decline in interest in geomorphology among geographers during the last half-century, as expressed by the constantly decreasing number of papers on morphologic subjects presented before that Association, Russell finds that it is partly owing to a healthy widening of the field of geographic inquiry, but partly also to a growing dissatisfaction with geomorphologic studies. For this reaction among geographers Russell believes that the geomorphologists themselves are to blame because they continue to cling to the physiography of the classical period, persist in perpetuating its misconceptions, close their eyes to later discoveries, and still stress the geologic and particularly the diastrophic interpretation of landforms. What Russell calls the classical geomorphology thus contributes little to an understanding of the relation between landforms and cultural geography. In its place Russell advocates the development of a geographical geomorphology, that is, "a factual study of landforms that cuts away from classical pattern..., tells us what is present in a landscape and... where each form is to be found."[1] As an outstanding example of such geographical geomorphology Russell mentions the Edelman-Tavernier survey of the Benelux countries, essentially a soil survey, which is now being undertaken as a cooperative venture of "agriculturalists, pedologists, sedimentologists, geologists, archeologists, paleobotanists, and other specialists."[2] The last named group includes also an historical geographer in the Dutch half of the survey. His assignment consists in providing the history of land use since Gallo-Roman time, the study of which often throws light on the causes of significant changes of the level of the land which cannot be explained by physical laws alone.

It is certainly refreshing to find a geomorphologist willing to admit that the field he serves is in great need of improvement. Most geographers will welcome the suggested change from classical geomorphology to geographical geomorphology, that is, to a geomorphology a geographer can really use. However, the role alloted to the geographer in establishing that desired geographical geomorphology is extremely small. In the enumeration of contributing scholars given above he appears at the tail end, preceded by a series of exact scientists, wielders of the microscope and the pipette. It appears that they are to do the yeoman work while the geographer is to enjoy the fruit of their efforts. It seems to me that such cooperation for the benefit of the geographer, with or without his assistance, will not materialize very frequently. In this plan the geographer is again relegated to the task of waiting for other people to do the groundwork upon which he can erect his own structure. Areas for which such detailed surveys are not available would become forbidden territory for the cultural geographer. Obviously the

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geographer cannot accept this postulate, and must therefore be willing to provide his own groundwork, including his own geomorphology.

Reading between the lines of Russell's address one gains the impression that geographers are ill prepared for that task. Geologists will readily agree with Russell and, I am afraid, also will the majority of geographers. The latter's reaction is obviously caused by the awe inspired at the ease with which geomorphologists are able to elucidate the evolution of a landscape from the very beginning of time. But Russell states correctly that such geomorphology is poorly fitted to provide the fundament for an anthropogeographic study and should be replaced by a geomorphology giving adequate answers to the questions of "what, where, and how much" in relation to landforms. It is my contention that the geographers can provide this kind of geomorphology themselves if they refrain from focusing their attention on the "why, how, and when" of landforms, that is, if they concentrate upon the lay of the land and leave the tracing of its complicated evolution since pre-Cambrian time to others.

As a means to this end I am here recommending an intensive search for regions of similar and of different landform types, which I propose to call geomorphic landscapes. I am also advocating clear empirical descriptions of these geomorphic landscapes, descriptions which provide a lucid picture of the scene upon which the human drama is to be unfurled, and which consider formative processes only to the extent that they improve the clarity of the empirical description.

Collegiate geomorphology is today still dominated by the postulate that landforms shall be presented deductively based upon consideration of structure, process, and stage. The postulate seems founded on sound logic and to guarantee satisfactory results. But like all deductions it must proceed from a series of assumptions which cannot be doubted, which are taken to be true. Often enough the distinction between assumption and fact is very fine, and serviceable assumptions easily become facts by force of their usefulness in the logical scheme although they are not corroborated by evidence. To some degree the possibility of a deductive explanation has eliminated any obvious necessity for a further search for facts, and has, for instance, hampered interest in processes because these are assumed to be known thoroughly and completely at the outset of the deduction. When evidence speaks against deductive reasoning a choice between the validity of the two has to be made. Veneration for the deductive argument often encourages a disbelief in the evidence.

A factor favoring the deductive presentation and classification of landforms consists in the logical simplicity of the method. But should not the fact that an average college freshman can easily master the theory and become an expert on landforms in a few weeks raise doubts in our minds concerning the quality of the theory?

The emphasis upon structure and stage in discussions of landforms obviously stresses the geologist's interest in diastrophism and in evolution during the geologic past. This does not coincide with the geographer's interest in landforms. His attention focuses on land use, which demands that principal attention be paid to lithology and to the landforms of today. Present-day college geomorphology thus obviously serves primarily the purposes of the geologist. In most cases the landforms in

themselves are of small interest to geologists but serve rather as tools which will enable them to unravel problems of structure, diastrophism, and the sequence of geologic events.

College geomorphology in the form in which it is taught at present also claims to provide the best possible descriptions of landforms, that is, explanatory descriptions. The combination of explanation and description appears entirely feasible, commendable, and therefore desirable. Whenever possible, the explanation is provided in terms of structure, process, and stage, thus again from a strictly geologic viewpoint. The description generally consists of an enumeration of the successive processes and cycles entering into the evolution of the landforms and is thus only an historical account which stops short at the point of paramount interest to the geographer, the period of recorded history. The lay of the land, the appearance of the combination of the landforms which make up the topographic landscape, is left to the reader's or listener's ability of deduction or imagination. The vaunted explanatory description is thus an explanation lacking a description.

Fortunately only a part of the terminology of geomorphology conforms to the demand for its being explanatory. The morphologic vocabulary contains such homely terms as moraine, cirque, drumlin, esker, roche moutonnée, boulder clay, outwash plain, valley train, kame, and others. Each of these readily evokes a picture in one's mind and is thus excellently descriptive. Obviously we need more of these terms, even if we have to continue to borrow the majority of them from other languages. The fine descriptive quality of these terms prevents them from being explanatory at the same time. True, the group of terms just enumerated fall all under the general heading of glacial landforms. But that indicates only a recognized relation to glaciation and does not represent an explanation. Two geomorphologists may readily agree in calling a hill of appropriate size and shape a drumlin, but may then enter into a heated argument as one maintains that it is a subglacial deposit while the other explains it as a terminal moraine which has been reshaped by an advancing ice sheet. The name thus does not imply an explanation. But the postulate of explanatory description has logically led to a demand for explanatory definitions of geomorphic terms. A fair explanatory definition of a drumlin should contain both explanations mentioned previously. Since this is poor pedagogy, as it evokes doubts concerning the authority of the instructor, or interferes with the clear logic of the deductive presentation, one explanation is commonly dropped. In the healthy argument between the two geomorphologists just referred to, the laurels might go to the one who can quote the textbook definition as indubitable proof of his infallibility. Or, if field evidence is overwhelmingly against him, he will end his side of the argument by stating that the feature is not a drumlin, since it does not conform to the definition. By retracting his original statement he will indirectly admit that he cannot trust his own observations and conclusions whenever they are in contradiction with the theory embodied in the standard textbook.

Obviously the effort to include explanations in definitions is deplorable. Faulty explanations are thereby solidly anchored in geomorphic nomenclature and are difficult to correct or to eradicate. This procedure also dampens all interest in elucidating the origin of morphologic features, as the definition fully explains them. These explanatory definitions also neglect the part of greatest interest to the geographer, the

adequate description of these features, which has again to be abstracted from the explanatory part of the definitions. Let us give preference to descriptive definitions of landforms which serve our purposes much better. We are then also in a position to give an unbiased presentation of the accumulated knowledge concerning the origin of these features, which will often indicate that not enough is known and that further observations are welcome. This scholarly attitude is also more worthy of the college level than is the attempt to attain a reputation of authority on a subject by answering all questions concerning it promptly and conclusively.

Dissatisfaction with the standard geomorphology has been voiced many times before by geographers. Many of them have recognized the fact that one of the major landforms of today, the hill country, has no place in the geologist's geomorphology, since it is not associated with a structure of its own and must thus be classified as a plateau or as a folded, faulted or complex mountain area, or may even be referred to as an eroded plain. That third dimension which is of such great interest to the common man, height of hills and mountains and depth of valleys and canyons, finds no recognition in the geologist's geomorphology. Instead, his interest centers on the amount of uplift and the thickness of material eroded off, but hardly ever in the amount left over.

In an effort to replace structure, process, and stage as foundations for geomorphic studies, some geographers have advocated the use of slope angle and relative relief in the consideration of landforms. The angle of slope is of importance in determining the agricultural use of a piece of land, as certain limit values of slope are conducive to soil erosion or to poor soil drainage, or may prevent cropping of the land altogether. Often enough depth of soil and soil texture are in direct relation to the slope of the land. The interest in the angle at which the earth surface falls away is thus well justified. But the small number of slope categories which can be established in cartographic representations, if clear separation of the categories is to be combined with a recognizable gradation in either color or ruling, limits the usefulness of this criterion. It serves well to differentiate areas of agricultural land from each other or from the rough, stony, non-agricultural land, but all slope differentiation in the latter is generally abandoned as useless. A map of slope angles cannot convey any clear idea concerning the landforms which bear the slopes of the different categories selected, and such a map remains a poor substitute for the contour map in that respect. The map of slope inclination is a functional map derived from the contour map, with a certain purpose in mind, as, for instance, agricultural utility. Being based on a single characteristic it fails to give a complete picture of the terrain. The same holds true for maps showing relative relief. The relative roughness or steepness of terrain which is depicted in such maps is again only a partial substitute for the landforms themselves.

Since neither current geomorphologic theory nor considerations of slope angle nor relative relief is able to provide a satisfactory morphologic foundation for geographic investigations, it remains to find a better one. Geographers are probably in agreement that a satisfactory investigation of landforms should consist of a complete and unbiased inventory of the morphology of an area, which should permit a complete understanding of its human use in all its varied forms. The inventory should serve not only for a consideration of its agricultural utilization but should also provide an insight into other problems, such as forms and distribu-

tion of settlements, choice of sites, and location and type of transportation routes. It matters little if one adheres to the theory of environmental determination of human endeavor or believes in man's deliberated choice among opportunities offered by the environment, for a good and clear picture of the physical environment still remains a prerequisite for any understanding of the human scene.

The demand for a complete survey and inventory of the landforms clearly eliminates any necessity for genetic explanations of the forms. It does not exclude explanations, however, especially if such explanations serve to improve the perception of the forms. But a genetic explanation is not required whenever the landforms are taken for granted, that is, when they only provide the framework or the basis for a theme in human geography. From the postulate of a complete inventory, it follows that not only those features be included for which genetic explanations can be provided but also all others, that is, forms for which more than one theory of origin are rampant and forms which are not understood at all genetically. In order to achieve this unbiased inventory of landforms, we have obviously to abandon preconceived ideas concerning them. We must thus discard all deductive classification and return to an empirical study of the landforms.

Since the geographer's interest centers on areas and regions, he is obviously not interested in single landforms but only in their regional integration. The geographer's ideal geomorphology is thus composed of an extensive array of regions of different geomorphologic appearance, that is, it consists of a system of regions of different morphologic type which I propose to call geomorphic landscapes. It is the assemblage of this collection of geomorphic landscapes which I am here advocating as the best means of establishing a true geographer's geomorphology.

Since the geographer is earth-bound he will not be interested in landscape types which might exist or which might have existed if certain processes had run their course according to a certain theory, but only in geomorphic landscapes which can be seen now. Obviously the base for this geographer's geomorphology cannot be found in deductive schemes but only in an extensive morphologic survey of the land, leading to a recognition of areas of similar and of contrasting surface configuration.

Work along these lines has already begun. The work of Nevin M. Fenneman comes readily to mind. The survey of physiographic regions which he started has only to be continued with sufficient emphasis on the geographic viewpoint, as done, for instance, by Freeman for the Columbia Basin. An intensive study of many of Fenneman's regions will permit further subdivision into areas of similar topography and thereby lead to the recognition of distinct morphologic types. But the emphasis on origin which runs through most sections of Fenneman's work has to be replaced by an emphasis on appearance of the landscape and the lay of the land. The empirical description thus has to replace the deductive explanation. The most fruitful improvement on Fenneman's work can be achieved in the morphology of mountain regions in which Fenneman's interest in origin caused undue emphasis upon the recognition of spurious remnants of debatable peneplains, and a total disregard of size, shape, and pattern of ridges and valleys which compose the mountains and which really affect human endeavor.

Work of establishing type regions of similar and of contrasting topography has also been started by the group of intrepid American geographers, like Finch and Seeman, who dared to elevate the hill country to a major morphologic region and thus broke away from classical deductive geomorphology, laying the foundations for an empirical and descriptive geomorphology along the lines advocated here. Their work has only to be continued and the number of types increased as surveys progress and regions of different morphology are recognized. Much can be learned also from numerous European geographers and geomorphologists, in particular French and German, who refused to follow the vogue for deductive and geologic treatment of landforms, and who still give empirical and inductive studies the consideration they deserve.

The search for geomorphic landscapes which I am here advocating fortunately demands no thorough geologic training. As a matter of fact, much of the physiographic theory acquired in the freshman year has to be unlearned in order to avoid the pitfall of substituting a long-winded hypothetical history of origin for the matter-of-fact survey of the landforms. For this reason it is quite probable that historical, economic, and cultural geographers will be more instrumental in the recognition of these geomorphic regions than will physical geographers. For the latter, the problems of origin and evolution are still the dominant purpose for any investigation of landforms. Their studies thus call for careful selection of pertinent isolated landforms which will prove their theses and for complete disregard of the others. The survey of landforms is thus more likely to be complete and unbiased if the landforms serve only as a factual base for a theme in human geography. The desire to find relations between human endeavor and topographic environment seems also more favorable to the search for and recognition of morphologic landscape types. Up to now human geographers have generally relied upon geologists to provide the morphologic background for their studies. Although often dissatisfied with the geologists' work they have not dared to improve upon it, as they frequently thought that landform description demanded the training of a geologist. If it is remembered that the geographer's interest in landforms differs from that of the geologist, it is quite obvious that the geologist's discussion of landforms of an area cannot satisfy the geographer, and that the latter must dare to provide his own morphologic background to fit his theme. Since that theme has nothing to do with diastrophism and earth history, no geologic interpretation of the landscape is necessary, and therefore also no extensive geologic training.

The recognition of the fact that the geographer's interest in landforms varies from that of all other scholars forcefully leads to the further conclusion that there exists a geographer's geomorphology which varies from the geomorphology of other scholars and which therefore only the geographer can provide. Very little headway has been made in the development of this geographer's geomorphology because the uniqueness of the geographic viewpoint has not been stressed in this field of investigation, although it has been asserted to exist often enough in relation to other fields or in abstract general terms. Only if we apply this unique geographical viewpoint to the study and classification of landforms will we arrive at a geomorphology which can serve as a base for the study of anthropogeography. Geographers have to undertake this study themselves since other scientists see landforms in a different light. Present-day college geomorphology cannot serve as a substitute because

it evolved as a tool intended to serve the purposes of geologic investigation.

Although the task of developing this new geographer's geomorphology, which I visualize as an extensive system of geomorphic landscapes, rests squarely with the geographers, they may accept assistance and can borrow from any and all non-geographers. Although present-day college geomorphology has been much belittled here as unsuited for our purposes, it nevertheless provides numerous excellent morphographic concepts in addition to its theory. They are found in those fields of geomorphology which are not suited for cyclic treatment, and are commonly grouped together as accidents, interrupting the cycle. I am referring to features of glaciation, of work of the wind, and of vulcanism. True, there is a so-called glacial cycle as well as an arid cycle, but they are not true cycles. There is no young, mature, and old glacial landscape because nobody has yet dared to suggest that the Canadian Shield represents a former mountain landscape eroded to an old land by glaciers. The so-called arid cycle is not applicable to all desert areas, as it fits only the Basin Range country. A differentiation between young, mature, and old volcanic features has thus far been attempted only by Lobeck. In these three fields in which a long deductive discussion based upon structure, process, and stage is not feasible, the void has been filled by an extensive listing of minor landforms, together with a voluminous vocabulary borrowed from all languages. The descriptive value of this vocabulary has long been recognized by geographers and they make extensive use of it.

It is unfortunate that the same extensive descriptive vocabulary has not been developed yet for features of stream erosion which are the most common in the landscape. It is obviously in this field that the geographers must concentrate their efforts at replacing the evolutionary terminology of the geologists by an empirical terminology of landscape types which convey a clear picture of what the land looks like.

We thus lack an adequate vocabulary for the most common features of normal erosion, the valleys. Canyon and gorge are the only terms which imply a certain shape in cross section, and even they are interchangeable. Ravine, gully, and dale are descriptive terms applicable only to small features, and even among these few terms the first two are practically synonymous. A similar dearth of terms exists for the parts between the streams. They are commonly referred to vaguely as interfluves or ridges, as if their shape was always the same. We have a good descriptive vocabulary for stream patterns for which terms like dendritic, rectangular, trellis, radial, and annular readily invoke a good picture. A corresponding vocabulary for their positive counterparts, the ridges, has thus far been provided only for the Ridge and Valley section of the Appalachians, where the zigzag ridges and the endless ridges have long ago been recognized and named. Their clear relation to structure has facilitated their entry into deductive geomorphology which otherwise frowns upon descriptive terms.

After sufficient single features of normal erosion of differing type have been recognized and named, the study of their grouping into form associations and the recognition of regions of dominant occurrence of such form associations will follow and will ultimately lead to an organized system of geomorphic landscapes of normal erosion.

The merit of the shift from deductive geomorphology to descriptive geomorphology which I am advocating here can be seen by comparing deductive or dynamic climatology with descriptive or statistical climatology. Based upon the knowledge of certain meteorological phenomena such as differential heating of land and sea, wind systems, air mass exchange, cyclonic tracks and ocean currents, dynamic meteorology is able to establish differences in climate between sea coasts and the interior of continents, between areas of low and high latitudes, and between east and west coasts. This has led to climatic classifications using such terms as marine west coast climate, modified marine east coast climate, subpolar continental climate, terms which are all clearly explanatory but provide no information concerning the climates themselves. Only by the use of climatic records do these terms become concrete and meaningful, and is it possible to compare the climate of one station or area with that of others. The logical application of this realization has led to the evolution of descriptive classifications of climate like those of Wladimir Koeppen or Warren Thornthwaite which are based exclusively upon meteorological records and which use such terms as humid tropical climate, cold steppe climate, subhumid mesothermal climate, arid microthermal climate, terms which are intended to be only descriptive and which have achieved a degree of precision by the choice of concrete boundary values. The two groups of classifications are obviously complimentary, the deductive and dynamic systems of climates providing the pattern of distribution of varied climates over continents while the descriptive and statistical classifications determine the actual areal extent of the different climates and establish variations and subtypes. The collection of climatic records and their extensive use in the definition of climate marks a progress over the deductive system of climates which we all recognize, even if we disagree concerning the relative merits of the exact classifications of Koeppen and Thornthwaite. It is my conviction that an intensive development of a descriptive geomorphology along the lines advocated here will, from the geographic standpoint, mark a similar progress over the standard explanatory geomorphology. The two forms of geomorphology will prove to be complementary and progress in one will be beneficial to the other.

The task of finding and assembling geomorphic landscape types which I am here proposing is arduous. It cannot be accomplished by the master stroke of a single individual but only through an intensive survey of the natural scene which demands the cooperation of many during a long period of time. Small and large contributions will be acceptable and will eventually lead to the desired geographer's geomorphology providing an accurate picture of the lay of the land upon which anthropogeographers can then develop the human scene.

LITERATURE CITED

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2. Russell, op. cit., p. 9.

TURMERIC: A GEOGRAPHICAL INVESTIGATION OF CULTURAL RELATIONS IN SOUTHEAST ASIA

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The subject of this article is a plant, the turmeric plant, and the position it occupies among the cultures of the many peoples from the Himalayas to Easter Island. This plant carries the botanical name of Curcuma domestica, and is closely related to the ginger plant, resembling it to a certain degree. The swollen, finger-like rhizomes or underground stems, or the powder obtained from them, are commonly sold on grocery shelves in the United States as a somewhat exotic ingredient in the preparation of oriental dishes. Those who have had the opportunity of trying and perhaps enjoying a dish of authentic East Indian curry and rice will recognize turmeric as the indispensable ingredient used in cooking both the curry and the rice which produces a characteristic yellow color. This yellow color is found in the rhizomes of the turmeric plant, and the powder is obtained most simply by grating or scraping the rhizome. It may be that the prominent use of turmeric in making curry depends more on custom and tradition and, in fact, on a preference for the yellow color, rather than on a special taste preference, because turmeric has only a mild musky flavor, which is often not very conspicuous among the many stronger spices employed in many kinds of oriental cookery.

However, besides its use in this way, turmeric, in the form of powder, a paste or the whole rhizome, is used by various peoples of India, Southeast Asia, Indonesia, and the Pacific Islands in several ways. It may be used to dye cloth, to paint the body or to act as a protective charm of a magical nature. The distribution of this plant and of these uses would seem to imply a very long history for the cultivation and use of turmeric in Southeast Asia.

The premise on which this report is based is that domesticated plants are, by their very nature, highly important indicators of human activity, and are as much to be examined in this regard as any type of archeological remains. The turmeric plant is technically a cultigen, that is, its original wild forebear is unknown, and it has been literally developed by man as a result of cultivating, selecting and perhaps crossing certain wild ancestors. In its present form it is not found wild except as an escape from cultivation, and in fact it cannot survive for long without care by man, except in especially favorable situations, because it has almost completely lost the power of seed reproduction. Thus, merely by finding out where turmeric is grown, we already have some information about cultural contacts and the spread of culture elements in the area under consideration. If we further determine how turmeric is used wherever it is grown, we may then obtain much stronger evidence for a widespread diffusion of culture traits. Thus, when we find that turmeric, which depends on man for its existence, is used in the same curious ways in Burma, Java, Timor, and out to the islands of the Pacific, we may safely suppose that this represents a widespread cultural diffusion. Finally, the answer to the question which peoples use it may give us some idea of the antiquity of this spread of culture. This is possible because if the plant and its special uses are found to be an integral part of the culture of quite primitive peoples, who lack many of the material posses-

sions of their more advanced neighbors, we then may suppose further that the plant was known, and the customs surrounding it were developed, in very ancient times, long before our historical knowledge of this area begins.

The Distribution and Uses of Turmeric

The ecological relations of the wild relatives of Curcuma domestica, and the climatic requirements of the plant, show that it belongs to the warm, but only moderately wet lands of monsoon Asia. This means areas having an annual rainfall of from 40 to 60 inches, with a mean temperature of something like 45° F for the coolest month. This limits the probable center of domestication of the plant to the hill country of Northeastern India, or to the drier foothills around the central plains of Burma, Siam and Southern Indo-China. Our present knowledge points to the Indian area as the most likely home of the plant. From this center the plant has evidently been distributed widely over southern India and Ceylon and along the Himalayan foothills, being cultivated nowadays under irrigation in the drier parts. It has been taken eastward by man to the other countries of Southeast Asia, to the islands of Indonesia, Micronesia and Polynesia as far as Easter Island and Hawaii. Also it was taken westward across the Indian Ocean to Madagascar. It is not found in Australia, but there are reports of its cultivation in the warm valleys on the eastern side of the Peruvian Andes.[1]

Turning to the uses of the yellow turmeric powder or paste, it is found that two areas are marked by particularly intensive use of these substances in the domestic life and ceremonials of the people. These areas are India and Polynesia. In India, turmeric, and in fact the yellow color in general, has a special position. It is considered lucky or auspicious. Clothes dyed, or rather stained temporarily, with turmeric are worn on special religious occasions. In certain rituals, particularly those associated with marriage, one finds the yellow turmeric paste very widely used as a face and body paint by the participants, giving them a shiny yellow appearance. Over most of India, of course, these practices are associated with Hindu beliefs and worship, but this identification is too general to be of use. Hindu culture is a complex mixture of earlier cultures, and in ascertaining the origin of a particular trait, within Hindu culture, one must look closely at the distribution of the trait within India itself. Working on these lines with regard to turmeric, it is found that this plant has an important place in the ceremonial practices of the so-called "primitive" hill peoples of Central and South India. Speaking in the broadest terms, these tribes may be said to have retained many of the culture elements of the pre-Aryan populations of India. Among these hill tribes, it is important to notice that the use of turmeric has a much more fundamental significance than among the Hindu populations. Among the hill peoples turmeric is directly associated with the cults of fertility and the worship of the earth or the Earth-Mother, as she is known. One example is the use of turmeric among the Khonds -- a tribe practising shifting cultivation in the hills of Ganjam and South Orissa. Until a hundred years ago, it was customary for these tribes to make an occasional human sacrifice in order to promote the fertility of the crops. Usually the victim would be smeared with turmeric, and the sacrifice, which was made to the earth goddess, was made exclusively in the turmeric fields. The British finally put a stop to the practice, but here is a report of an eye-witness made prior to that in 1844, when the Government was collect-

ing information on the subject:

Question: Did you ever see the sacrific performed, as you describe, or only heard of it?

Answer: In that country all do it. Everyone knows it.

Question: What god has such sacrifices?

Answer: In the fields where turmeric is grown they perform these sacrifices, and the Khonds sacrifice to them (that is, the earth goddesses). All round the turmeric fields they bury the flesh of men.[2]

Examples such as this and other kinds of evidence may be multiplied, but they all add up to the conclusion that in India, pre-Aryan peoples regarded turmeric as a special, magical plant closely associated with the earth. Possibly, this is because its qualities of vigorous growth and its distinctive yellow color suggested that the rhizome was endowed with the equally powerful magical strength of the earth itself. Later on, this attitude became a part of general Hindu beliefs and ceremonials.

Moving south-eastward through Asia, occasional traces of the same attitude are found in Burma and Siam, but it is really in parts of Indonesia and finally in Polynesia that one finds the turmeric "cult", if one may call it that, fully developed. In Indonesia, some of the uses of turmeric are, quite simply, Hindu. They were introduced by the early Hindu rulers of Sumatra and Java and gradually filtered down to the mass of the native people. But among the few remaining primitive populations of these islands, one finds again that turmeric is very important in ritual, and often has the character of a sacred plant, or at least one that will bring good fortune or increase fertility. The people of the Mentawei Islands may be considered in this regard. These people, who were isolated for centuries from the movements of culture which affected the mainland of Sumatra, represent a very primitive, and therefore early, form of Indonesian culture. This is shown by the absence among them of some of the cultural items that are common in Indonesia. The people of Mentawei did not cultivate rice until very recently, nor did they weave cotton. However, among them, turmeric has a most important place as a sacred plant, and is used at all ceremonies connected with the major phases of domestic life. It is used in the same way as among the hill tribes of India, that is, as a stain for the ceremonial bark cloths, as a protective personal charm. The shaman rubs it on the bodies of the chief participants in ceremonials having to do with birth, death, marriage and initiation. It is universally regarded as being pleasing to the spirits. A similarity between these customs and those of the tribes of Central India is undeniable, and the unavoidable inference is that these two groups of relatively backward, relatively isolated peoples have common cultural antecedents. For the purpose of this paper, it implies a very great antiquity for the selection and domestication of the turmeric plant. This would, moreover, appear to have taken place before the introduction of rice cultivation into the East Indies.

We have, in Polynesia, similar evidence regarding the date of the original domestication of <u>Curcuma domestica</u>. Some of the peoples of

Polynesia, like the people of Mentawei, appear to have left the mainland of Southeast Asia before rice had come into use as an item of cultivation. However, among the inhabitants of the islands from Fiji and Rotuma eastward to Mangareva and Easter Island, and northward to Hawaii, not only is turmeric found as a cultivated crop, but it is also regarded with great esteem by them as a sacred or semi-sacred plant. The fact of its cultivation can only mean that it was taken as a cultivated plant by the Polynesians or their predecessors from Southeast Asia. The fact that it is used in the same way as in India and Indonesia implies that Polynesian culture shares something in common with the cultures of the primitive populations of the other two areas. The customs of the people of Mangareva, the island lying to the southeast of Tahiti and the Society Islands, may serve as an example of Polynesian culture, which is surprisingly uniform over a very large area. In Mangareva, the fertility motif, which is so prominent among the primitive peoples of India, is very strongly developed, to judge from the accounts of early European travelers and missionaries to the island. Turmeric was rubbed by the high priest on pregnant women, it was rubbed on the cheeks of the bride and a special bowl of the paste was kept during the lifetime of the head of the household to be used exclusively for rubbing his body after his death. It was used as a charm and was thought to be a sovereign remedy for many diseases. Throughout Polynesia, turmeric was thought to be very pleasing to the gods, and the great esteem in which it was held is shown by the manner in which the pigment or paste was prepared. This preparation was a family, and often a communal, affair of great solemnity, accompanied by strict taboos on any kind of improper behavior which might offend the gods. Especially chosen priests of high rank were in charge of the entire operation. If the results were unsatisfactory they were rejected, and the entire tedious process had to be repeated.

Another aspect of turmeric cultivation that should be mentioned is its position in what may be called the "rice cultures" of Indonesia, Malaya and Southern Indo-China. Among the peoples in this area who grow rice, both as upland dry rice and lowland wet rice, turmeric is without a doubt regarded as a plant with the power of increasing the fertility of the rice crop. This association with rice cultivation is merely an extension of the ideas found among such people as the Mentawei islanders who lack rice. But here, in addition, the yellow color of the turmeric rhizome is believed to have control over the ripening, that is, the turning yellow, of the rice crop. For this reason, turmeric is often planted at the corners, or along the borders, of the rice clearing, or the paddy field. There is no idea here of mixed cropping, for after the rice harvest the magic-working plant is simply left by the field-side. Furthermore, turmeric powder is sprinkled over the harvested rice, and some rice mixed with turmeric is offered to the female "Spirit of the Rice", who is often almost identical with the Earth-Mother. This association of turmeric with rice cultivation is also very ancient. It is found among the people of Eastern Celebes and some of the Moi tribes of Annam who grow only upland rice, and know nothing of irrigated paddy fields. Yet almost identical customs are found among the lowland wet rice cultivators of Bali and Lombok, although here there is a great elaboration of the ritual owing to the incorporation of Hindu magic. Nevertheless, this fundamental similarity between the ritual use of turmeric in rice cultivation by the primitive users of the digging-stick on the one hand, and by the most civilized Malay peoples on the other, shows that, as suggested above, the trait is of great antiquity.

Conclusion

The study of the geographic distribution of the turmeric plant and its use provides evidence of a culture trait which was common to a prehistoric Southeast Asiatic population, whose economy was based on shifting cultivation with the digging-stick. This trait later became a part of the Indonesian rice culture. Many elements of this complex, including the ritual use of turmeric, are also found among mainland groups, such as some of the Moi tribes of southern Annam. Moreover, it has been inferred from culture-historical evidence, that the use of turmeric in many of the "digging-stick" cultures of Southeast Asia and Malaysia, and the later transference of this trait to rice-cultivating peoples in this area, must have occurred much earlier, probably some millennia earlier, than the movement within historical times of Hindu culture to the east. This later movement of Hindu culture eastward perhaps expanded the variety of application of the trait, and perhaps did more thoroughly distribute it, but the Hindus cannot be considered the originators of the cultivated plant or of its primary uses.

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WATER PLANNING IN THE WILLAMETTE BASIN

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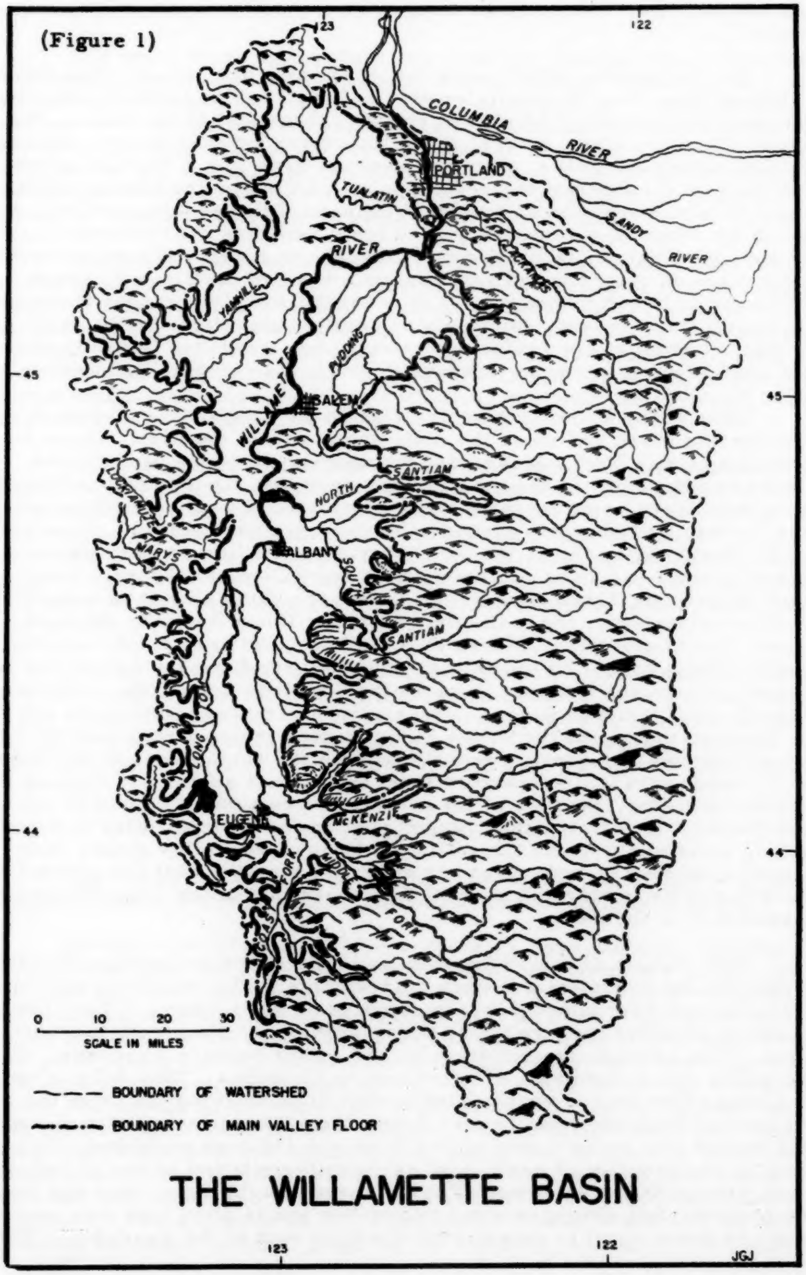
The Willamette Basin is the heartland of Oregon. Two-thirds of the population and the three largest cities of the state are within its bounds. From its farmland comes over 40 percent of the state's farm income and on its slopes and bordering areas are the largest reserves of mature saw timber in the United States. The rate of population growth of the Willamette Basin in the past decade has been more rapid than that of any other comparable area in the Northwest and continued growth is to be expected. Although most of the new population has been absorbed in war-stimulated industries and timber activities, much of the future growth must be supported by expanding the agricultural base. There are 2,700,000 acres under farm ownership, of which nearly one-half is cropland.[1] The area capable of producing crops cannot be greatly increased. However, it can support closer settlement through more intensive use. Nearly 80 percent is now devoted to grains, grass and forage seeds, hay and low yielding pasture. Some of this land can be used more intensively when the demand arises through better crop selection. However, the greatest possibilities can be achieved only through expanded and improved water control measures.

Physical Background of Water Problems

The water problems of the Willamette Basin are unique. A combination of humid winters and arid summers, streams which flow from the slopes of the surrounding mountains through the flat central floor and soils with a high clay content make flood control, drainage and irrigation parallel needs if the land and the water resources are to be fully utilized. A knowledge of the physical geography of the basin is basic to an understanding of these problems.

The surface features of western Oregon are best visualized when it is recalled that the entire West Coast of the United States is characterized by two parallel mountain chains that enclose a series of central basins. In Oregon the Coast Range on the west and the Cascades on the east enclose the drainage basin of the Willamette River, which is approximately rectangular, extending north-south 150 miles and east-west 75 miles with an area of about 11,200 square miles (Figure 1). In the south the basin is terminated by the Calapooya Mountains which form the connecting link between the Coast Range and the Cascades and cannot be sharply differentiated from either. The Columbia River marks the northern boundary. The area to which the name Willamette Valley is applied is the central portion of the basin, from Cottage Grove northward to Portland, that contains the farmland. The valley is about 130 miles long and 25-30 miles wide with an area of approximately 3500 square miles.

The surface of the Willamette Valley, generally below 500 feet in elevation, is for the greater part the flat to rolling alluvial plain of the Willamette River and its tributaries. The valley is limited on the west by gently rising foothills of the Coast Range and on the east by the more abrupt rise of the Cascades. The central and northern portions of the valley floor have more varied relief owing to extensive amounts of basalt



(Figure 1)

THE WILLAMETTE BASIN

which were intruded through the older sediments to produce local ridges and rolling hills. Valley floor comprises about 78 percent of the arable land.

The Willamette River has a low gradient in the valley. The fall on a straight line from Eugene (elevation 422 feet) to Oregon City (elevation 163 feet), a distance of 94 miles, is under three feet to the mile. The actual fall of the river is less, since its course between the two cities is approximately 160 miles, giving an average drop of 1.6 feet per mile. The downward cutting of the river has been halted by the basaltic obstruction over which it drops 45 feet in Willamette Falls at Oregon City. As a result the river is at temporary base level, and has characteristics of old age, particularly in the upper valley where in many places it breaks into a maze of channels and sandbars in a braided pattern and moves northward in broad meanders. The present flood plain ranges from one-quarter to three miles in width and is gently undulating. In the past, as a result of erosion and avulsion, the river has wandered laterally over this area forming secondary channels, dead-end sloughs, and oxbows.

Most of the major tributaries rise in the Cascades at elevations of 6000 feet or more and enter the main stream from the east. These include the Middle Fork, McKenzie, Calapooya, Santiam, Mollala and Clackamas Rivers. In the mountainous sections, these streams flow in narrow V-shaped canyons with steep gradients. Lower down the gradients flatten, and channels meander between gravel terraces. Upon reaching the main valley floor, the several tributaries flow on very gentle slopes to their points of confluence with the Willamette River. Coast Fork Willamette River rises in the Calapooya Mountains, and numerous small streams enter the main stem from the Coast Range to the west. These rise at elevations of less than 2000 feet and have much smoother profiles from source to mouth than do the rivers from the east. The important tributaries entering from the west include Long Tom, Luckiamute, Yamhill, and Tualatin Rivers. Generally, the main stream flows near the western margin of the valley owing to the greater strength of the eastern tributaries and greater deposition from the east. Most of the tributaries enter with little departure from the normal angle, but some of the smaller streams, because of the natural levees along the main stream, flow parallel to it in typical "Yazoo" fashion for several miles before effecting junctions. Above Corvallis the floor of the valley slopes from east to west four to seven feet per mile; the result is that the channel of the Willamette is elevated several feet above that of the Long Tom which parallels it to the west.

The climate of the Willamette Valley is characterized by dry, moderately warm summers and wet, mild winters. The frost free period averages 200 days although hardy crops grow much longer. The climatic factor of greatest concern to the water problem is the precipitation regime. The average precipitation for the entire basin is 61 inches. On the valley floor, however, it decreases to 40 inches. This falls largely in a long rainy season which extends with little interruption from the latter part of September until early June. Excessive precipitation during this period is a major cause of the flood and drainage problems. In contrast to the problem of heavy cool season precipitation is one of deficient precipitation in the summer. For the three months June, July and August the total rainfall averages about two inches and is often less than one inch, or about equal to that of arid districts east of the Cascades. This

is too little for profitable production of many late maturing crops without the aid of supplemental irrigation.

The soils of the valley floor are alluvial, brought down from the bordering slopes and laid down under widely varying conditions to form one of the most complex patterns in the United States. Residual soils occupy some of the higher areas. The soil forming materials of the valley floor fall into two groups: recent alluvial deposits occupying about 270,000 acres, and old valley filling deposits of some 1,200,000 acres.[2] On the lower slopes bordering the valley floor slightly over 1,000,000 acres of residual soils are included in farm ownership.

The recent alluviums on the undulating surface of the river bottoms in the main range from deep, fertile, heavy sandy loams to clay loams. Highly productive under both dry and irrigation farming techniques these soils form the base for most of the intensive production in the Willamette Valley. They contain the major portion of the land now irrigated, because of wide adaptability and the ease of distributing water by comparatively small-scale low-pressure sprinkling systems taking water from shallow wells or adjacent streams and sloughs.

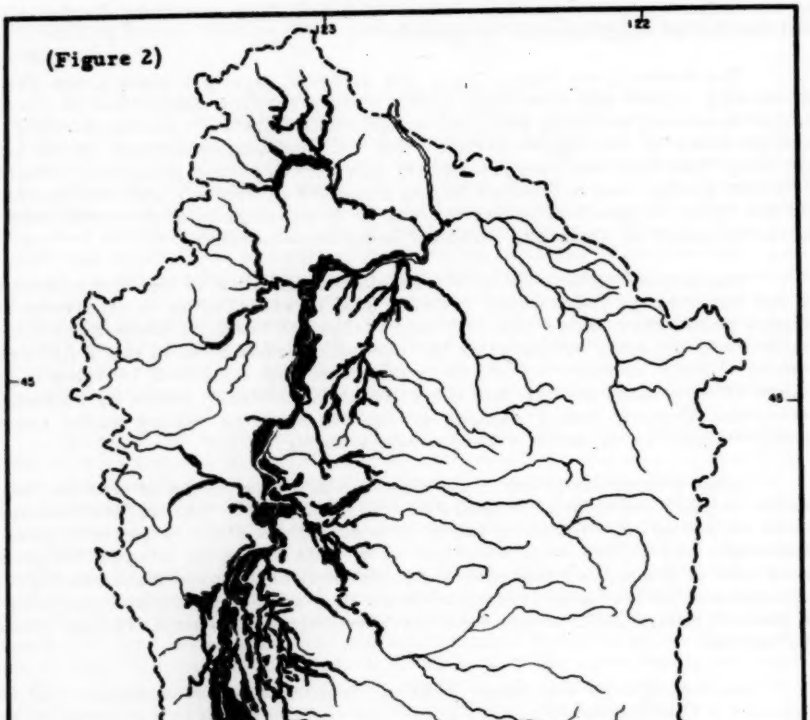
Soils composed of the older alluvial deposits range in texture from loams to clay loams with slightly heavier subsoils. The darker colored soils of this group, found on lands with sufficient slope to provide good drainage, are suited to production of a wide range of crops. Slightly over half of the soils developed from older alluvial materials are light colored and lie on level surfaces where they have unfavorable conditions of poor drainage and, at present, have restricted adaptability and return low yields.

During winter the heavy rainfall maintans all Willamette Valley soils in a thoroughly saturated condition and causes local ponding in the areas of poor drainage. The heavier soils are slow to drain in the spring but become dry and hard during the summer if not properly handled. Both drainage and irrigation are needed to maintain a proper balance of soil moisture.

The Water Problems

The water problems of the Willamette Valley are manifest in three forms: floods, drainage needs, and supplemental irrigation needs.

Stream flow follows the same cycle as precipitation. During the cool season when the streams, greatly augmented with rain runoff, leave the highlands and emerge onto the flat floor of the valley their velocities are reduced and their crests naturally rise. The low absorptive power of the old valley soils causes rapid runoff where natural drainage ways are good, and a difficult problem of standing water where drainage ways are lacking. During the winter and spring of every year, the discharge of the Willamette River and major tributaries reaches or exceeds bankfull capacity at critical points. Except in years of unusually low runoff about 100,000 acres are inundated annually, and frequently recurring floods cover from 150,000 to 270,000 acres. The two largest floods of 1861 and 1890 inundated 513,000 acres and 485,000 acres respectively.[3] (Figure 2.) The Albany area has experienced 82 floods since 1893, ten of which exceeded bankfull stage by as much as ten feet.[4] Not only do



FLOOD PLAIN OF MAJOR FLOODS-1943 & 1945

floods do great damage to property, but they limit the variety of crops that can be grown in many areas, restrict others to pasturage, and render some useless. Optimum utilization of Willamette Valley farmland requires flood control.

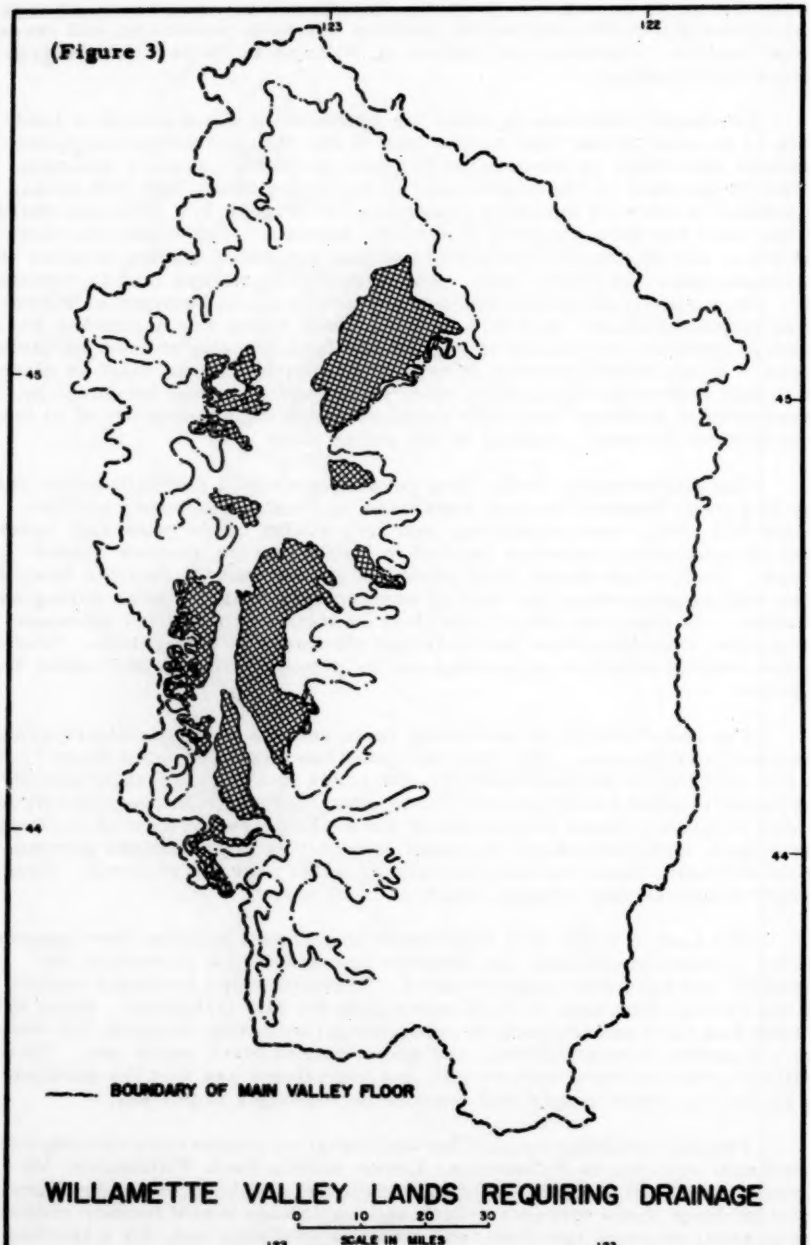
Drainage conditions restrict the adaptability of considerable land. Only 22 percent of the total arable land of the valley floor has sufficient gradient and outlet to streams to produce normally adequate drainage. About 30 percent of the arable land of the valley floor, 480,000 acres, is subject to adverse drainage conditions.[5] (Figure 3.) Only one-third of this land has direct outlets to stream channels. The remaining outlying areas are seriously affected by ponding and water logging because of flat topography and heavy soils. The adaptability of such land is restricted. The majority of field crops are either seriously damaged or killed when inundated longer than five days. In such cases where ponding occurs, it becomes necessary to replant the land, usually to less valuable crops. When inundation may be expected frequently, land must be planted to fast maturing crops which often result in low annual income. Improvement of drainage facilities could increase the adaptability of at least one-third of the total cropland of the valley floor.

The effectiveness of the long growing season in the Willamette Valley is greatly reduced by arid conditions in the three summer months. While fall sown, early maturing, and deep rooted crops grow well under natural conditions, summer rainfall is inadequate for shallow rooted crops. Such crops whose chief period of growth comes after the first of June will require about one inch of supplemental water a week during hot weather. Pasture requires from 16 to 24 inches of water for optimum production depending upon methods and efficiency of application. Truck crops require about 12 inches and can be grown profitably only under irrigation.

The possibilities of increasing farm returns have stimulated great interest in irrigation. The area irrigated has expanded from about 12,000 acres in 1930 to an estimated 90,000 acres in 1950. Recently the State Engineer's office has been processing over 1000 applications annually for water permits. About 60 percent of the present development is on flood-plain land, with individuals or small cooperative organizations pumping from streams, other surface sources or wells near the streams. Four larger cooperatives irrigate a total of 5000 acres.

The lack of water will soon restrict private irrigation development. Under present conditions, the summer low water flow of most of the streams has been over-appropriated. There is water available earlier in the spring, but there is little remaining for late irrigation. Some difficulty has been experienced in reconciling conflicting demands for water for irrigation, industrial use, and domestic and stock water use. This difficulty has not been serious yet, but indications are that the problem of irrigation water supply will become increasingly important.

Two possibilities remain for individual or cooperative development. For lands adjacent to Willamette, Lower Middle Fork Willamette, McKenzie, and Santiam Rivers, some water can still be obtained by appropriation from these streams. Such appropriations would further reduce the present summer low flow, and water is available only for a fraction of the land that could be irrigated. The second alternative is to pump


(Figure 3)
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BOUNDARY OF MAIN VALLEY FLOOR
WILLAMETTE VALLEY LANDS REQUIRING DRAINAGE
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SCALE IN MILES
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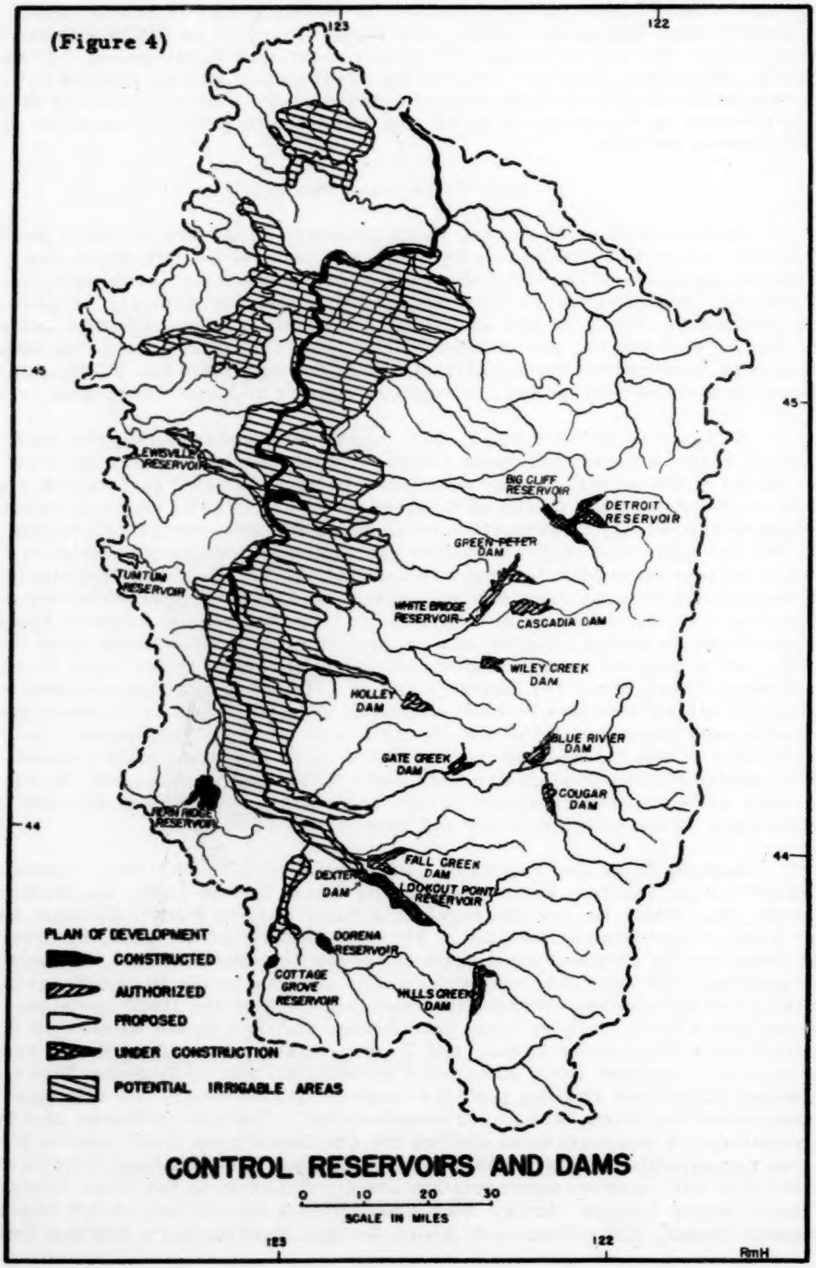
from the ground water reservoir. The supply under the valley floor is extensive and of good quality. On the floodplain it can be easily tapped by shallow wells, but on the higher, old valley floor, 50 to 100 feet above the river level, the cost of deeper wells has restricted development. It appears, therefore, that any large scale development will be limited until government sponsored projects are constructed. This will require storage of water on tributary streams and diversion to gravity canals for distribution to the land.

The Willamette Project

During the past 80 years, the Willamette River and its basin have been the subject of many investigations and reports by both State and Federal agencies. The most thorough study of the water problems, made by the Corps of Engineers, has resulted in a plan for multiple purpose development. The plan has as its objectives the construction of a series of dams, reservoirs, and related works to control floods, improve major drainage, and permit the beneficial use of the waters of the Willamette River system for irrigation, navigation, power and other purposes.

A plan was authorized in 1938, but severe floods during the next decade made it clear that more complete control of the river would be required if the primary objectives were to be achieved. A detailed plan was included with the Corps of Engineers report.[6] The main features (Figure 4) are: (1) Construction of 19 dams and reservoirs to provide 2,087,000 acre feet of flood control storage; (2) Construction of 87.4 miles of levees on Middle Fork Willamette, McKenzie, and Willamette Rivers in the Eugene area to supplement flood control effected by the reservoirs; (3) Improvement of channels on 17 tributaries to provide flood control and drainage benefits and on two tributaries to provide flood control, and a general program of clearing and snagging on the main stream and main tributaries; (4) Construction of 171 bank protection projects to keep the major streams in firm channels; (5) Construction of power generation facilities at eight of the 19 dams with an installed capacity of 389,000 kw; and (6) Reconstruction of the locks passing traffic around Willamette Falls and such dredging and contraction work as will be necessary with stream regulation to secure controlling depths of six feet to the mouth of the Santiam River and five feet to Albany.

Sixteen dams and reservoirs have been authorized. Only Tumtum Reservoir on Tumtum River, Lewisville Reservoir on Little Luckiamute River, and White Bridge Re-regulating Reservoir on Middle Santiam River have not yet been authorized. The development of the plan, however, is governed by congressional appropriations for construction. Priority of projects has been determined by need, and has so far included partial control of tributaries contributing most severely to the flood problem. Fern Ridge Reservoir on Long Tom River, Cottage Grove Reservoir on Coast Fork Willamette River, and Dorena Reservoir on Row River are complete. Lookout Point Reservoir on Middle Fork Willamette River, Detroit Reservoir and Big Cliff Re-regulating Reservoir, all with power generation facilities, are under construction. The war in Korea and the preparedness program have shifted the emphasis from flood control to power generation. It is probable that dams and reservoirs with power facilities will receive appropriation for construction in the near future. These would include Dexter Dam immediately downstream from Lookout Point, Green Peter Dam and White Bridge Reservoir on Middle Fork


(Figure 4)
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LEWISVILLE RESERVOIR
BIG CLIFF RESERVOIR
DETROIT RESERVOIR
GREEN PETER DAM
TUMTUM RESERVOIR
WHITE BRIDGE RESERVOIR
CASCADIA DAM
WILEY CREEK DAM
HOLLEY DAM
BLUE RIVER DAM
GATE CREEK DAM
COUGAR DAM
FERN RIDGE RESERVOIR
FALL CREEK DAM
DEXTER DAM
LOOKOUT POINT RESERVOIR
DORENA RESERVOIR
COTTAGE GROVE RESERVOIR
HILLS CREEK DAM
PLAN OF DEVELOPMENT
CONSTRUCTED
AUTHORIZED
PROPOSED
UNDER CONSTRUCTION
POTENTIAL IRRIGABLE AREAS
CONTROL RESERVOIRS AND DAMS
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Santiam River, Cougar Dam on South Fork McKenzie River, and Hill Creek Dam on Middle Fork Willamette River. Channel clearing and snagging on Willamette River and 19 tributaries and channel improvements for flood control and major drainage at 16 locations have been authorized. Bank protection work is now in progress as needs arise. The supplementary levees will not be constructed until all flood control dams and reservoirs are completed.

Benefits of Water Control

The possibilities that will accrue from water control will have far-reaching effects upon land utilization in the Willamette River Basin. The annual property damage due to floods will be reduced by 85 percent. Furthermore, damage from runoff comparable to the floods of 1861 and 1890 will be greatly reduced. Streams will remain in fixed channels. The most important ramification of flood control from the standpoint of population growth will be the possibilities for intensifying land use. There are 15,900 acres of the present flooded timber, bush and waste lands which may then be converted to pasture, and 10,600 acres to cropland; 44,890 acres of flooded pasture land may be converted to cropland; and 24,780 acres of cultivated lands now in low value crops may be converted to higher uses.[7]

Drainage will be materially improved by work being done and planned for the major channels. The improvement of major drainage channels will make existing interior drainage systems more effective and opportunity will be provided for installations of additional interior facilities. This local work is outside the realm of the Corps of Engineers. However, the Soil Conservation Service now is established in the valley and will, undoubtedly, become active in drainage work as well as other conservation practices. Purely an advisory group, the Soil Conservation Service will give the farmers advice as to individual and community projects to make proper and best use of main drainage channels. The Production Marketing Administration is represented in all the counties of the Willamette Valley with a large membership of farmers who are receiving compliance payments for following various recommended conservation practices.

Drainage will be improved on 480,000 acres of valley land. Drainage opportunity will be provided by reservoir control of floods on 320,400 acres and by channel improvement and levees on 160,000 acres.[8] This will benefit agricultural land use along the following lines: (1) increase yields from present types of crops, (2) increase adaptability of present farm land, (3) increase in the area farmed by conversion of some land now in pasture to crop production, and (4) decrease in the cost of field operations by reducing the necessity for field divisions due to drainage and allowing more flexibility as to time of cultivation and planting.

Preliminary studies by the Bureau of Reclamation indicate that water resource development in the Willamette Valley can include a sevenfold increase in irrigation (Figure 4). Twenty-two projects with a total irrigable area of 620,800 acres have been determined feasible. Water to be stored in authorized reservoirs could supply the bulk of this area without material conflict with other purposes. At the present stage of planning, the individual farmers are the greatest obstacle to government sponsored projects. Farming under normal rainfall has generally been profitable in the Willamette Valley and many farmers are unwilling to cooperate in any

large-scale irrigation development at this time[8]. Only one small project, the Canby Project, comprising 3,270 acres of irrigable land, has been requested for development by the Bureau of Reclamation.[9] The benefit of supplemental irrigation has been proven by over 25 years of investigation by the Oregon State College Agricultural Experiment Station and by the practice of an increasing number of individual farmers. The values can be best understood by examination of the response of several crops. On the bottom land the yields of alfalfa hay are doubled, the yields of potatoes are increased 115 percent, and red raspberries 58 percent. On the old valley filling soils irrigation increases the yields of alfalfa 50 percent, potatoes 63 percent, carrots 72 percent, and grass 54 percent. With such increases in production possible, it seems probable that irrigation developments will result from increased population in the Willamette Valley and growth in markets for irrigated crops.

Conclusion

In the decades ahead, the population of the Willamette Valley will increase and the resource base will be called upon to provide additional employment opportunities. The soil resource must be developed to its greatest potentiality in order to meet this need. Since no great expansion in agricultural land is possible, the future rests upon intensification of land use which will be made possible through water control and development.

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THE ASSOCIATION OF PACIFIC COAST GEOGRAPHERS

Thirteenth Annual Meeting, Salt Lake City, Utah, June 22-24, 1950

The thirteenth annual meeting of the Association was held at the University of Utah, Salt Lake City, in conjunction with the annual meeting of the Pacific Division, American Association for the Advancement of Science. Four half-day sessions were allotted to the presentation of papers, the meetings being held in the Department of Geography. A short business meeting was held after the morning session on June 23. The address of the retiring president was presented at the annual dinner meeting held in the Union Building on the evening of June 22. An all-day field excursion explored the hinterland of Salt Lake City June 24.

Program, with Abstracts of Papers Presented

(Papers published in full in this issue are not abstracted here)

THURSDAY MORNING SESSION, JUNE 22

Physiographic Mapping with Aerial Photographs, Cottonwood Creek, Washington. FRANCIS J. SCHADEGG, Eastern Washington College of Education.

Abstract: This paper was given to demonstrate the utility of aerial photographs and a technique for using them in physiographic research. The area studied was a nine-mile square section extending from the flood plain of the Colville River to the intermediate slopes of the Pend O'reille Mountains at about 4000 feet elevation. The hilly and mountainous preglacial topography is covered to considerable depths by pleistocene glacial deposits below 3000 feet elevation and a thinner covering above that elevation. In retreat an embayment of ice occupied the area with a melting front facing southwards and east. Minor topographic features, including ice margin deposits, meltwater drainage channels, and ice margin erosion channels, suggest the nature of ice retreat. At least five positions during retreat are indicated by well defined meltwater drainage channels and ice margin deposits.

Four steps were followed in the procedure used in this study. (1) General down-the-road field reconnaissance resulted in a map of physiographic surface materials. (2) Scanning of aerial photographs and study of selected stereo-pairs preceded the construction of transparent overlays of critical areas. An overview of topographic relationships resulted that would not ordinarily be revealed until many days of detailed field mapping had provided the necessary facts. (3) Field study of selected areas checked the pattern and established the facts concerning the features associated with ice retreat. (4) Construction of maps and recording of all data preceded analysis of facts. Use of controlled aerial mosaic maps for field mapping and final recording of results is a more ideal procedure, but was not possible in this study.

Maps available for the area included those in the County Assessor's office showing roads, buildings and section lines on a scale of 4 inches to the mile, and U. S. G. S. topographic maps on a scale of 1:125,000 with 100 feet contour intervals. Aerial photographs and stereoscope were available at the Soil Conservation Service office at Colville.

Conclusions are that this method effects a considerable saving of time and makes it possible to relate topographic features more easily

and to more readily understand their meaning. This is especially true in studying an area inadequately supplied with roads and lacking in detailed topographic maps. It is estimated that without the use of aerial photographs at least double and possibly three times more time would be needed to reach the conclusions attained in this particular field study.

Sequent Land Use of Bridgeport Bar, Washington. EDWARD C. WHITLEY, Wapato, Washington.

Abstract: A few miles north of Chief Joseph damsite is the low-lying Bridgeport Bar. Here, opposite the mouth of the Okanogan River, is a clearly defined region which has undergone many changes, and which today stands at the beginning of a new era. The arid climate, under continental influences, has made irrigation necessary for successful agriculture. Four to five square miles out of the seven square miles of the bar are cultivated.

Prior to the coming of the white man Bridgeport Bar lay athwart Indian communication lines. From 1811, when Fort Okanogan was built, until 1909 the chief use was also as a transit area with some placer mining, homesteading, and grazing late in the period. Extensive apple orchard development by eastern interests, beginning in 1909 and, with periods of retrogression, extending to the early 1930's constituted the most comprehensive utilization. A period of relative disuse, with only a few orchards remaining, lasted from 1932 until 1950. The new era, directly related to the construction of Chief Joseph dam, bodes well for the temporary prosperity of the region while the dam is built built, but another period of readjustment will follow completion of the dam.

Water Planning in the Willamette Basin, Oregon. RICHARD M. HIGHSMITH, JR., Oregon State College. Published in full in this issue.

Corridor Functions of Davis County, Utah. ELAINE BJORKLUND, University of Utah. No abstract received.

Des Moines: Origin and Growth. HOWARD J. NELSON, University of California, Los Angeles.

Abstract: Des Moines in 1950 is a city of functional diversity, occupying an irregular, built up area of some 30 square miles, shaped like a four-leaf clover, located near the center of agriculturally rich Iowa. Des Moines began as a temporary military post whose site and situation were in harmony with the requirements of 1843. Abandoned by the soldiers two years later, the barracks became the nucleus of a small settlement. Road and river connections to eastern Iowa towns and a well-known name were initial advantages. Selection of the settlement as a county seat, over considerable opposition, the establishment of a Land Office and the commercial activity supplying an increasing number of settlers, aided early growth. The relocation of the state capital in the city in 1856 insured the permanent importance of a place that up to this time was merely one of a number of frontier towns. Des Moines was chosen only after much discussion and the consideration of many alternative possibilities. With the arrival of the railroad in 1866, the last major element necessary for the development of the modern metropolis was at hand.

A steady growth of diversified functions, rather than periods of dominance by first one function and then another, has characterized the development of economic activities in Des Moines. Recently commerce,

retail and wholesale trade and insurance, has increased in importance. Manufacturing has relatively declined slightly, though ironically it is in publishing and printing that Des Moines reaches its most completely nation-wide market.

The alignment of the cabins of the early fort is reflected in the layout of the street pattern of the present business district and the commercial core has migrated only a short distance from its original site. Today Des Moines seems the logical and "natural" sort of a city to have grown up at its present location. Investigation discloses that a long series of decisions by numerous individuals and groups has played an important part in the origin and growth of the city.

Brigham City, Utah: The Only Incorporated Communistic City of Its Age. CHARLES M. CHESTNUTWOOD, University of Utah.

Abstract: A study of the origin of Brigham City reveals a story of a pioneering people beset with innumerable hardships, occasioned by the attempt to wrest a home and a living from a begrudging nature. Despite the preponderance of unfavorable conditions for developing a successful urban community, the Mormon pioneers, endowed with a judicious, theocratic leadership, and an avowed sense of cooperation, soon developed the only incorporated communistic city of that period.

Soon after the settlement of the town, a city-wide cooperative movement, the Brigham City Cooperative Mercantile Association, was established. Success followed rapidly until the citizens owned and were operating such varied industries as a tannery, a dairy with 600 cows, a herd of 15,000 sheep, a woolen mill, a boot and shoe factory, a construction company and a number of other factories. The demand for the products of the Association continued to increase until it became necessary to import supplies from as far away as Southern Utah.

However, continued success of this movement was primarily contingent upon the prolongation of the regional isolation of the Mormon people. With the completion of the first transcontinental railroad and the subsequent westward influx of people with philosophies adverse to Mormon ideologies, this great social experiment in universal cooperation was slowly but gradually forced to admit defeat.

Turmeric: A Geographical Investigation of Cultural Relations in Southeast Asia. DAVID E. SOPHER, University of California, Berkeley. Published in full in this issue.

THURSDAY AFTERNOON SESSION, JUNE 22

The Cheese Industry of Bear Lake Valley, Idaho. S. ELLIOTT BUDGE, University of Utah.

Abstract: Bear Lake Valley is located in the southeast corner of Idaho and the most northeastern corner of Utah. The valley floor is approximately 6000 feet above sea level, and is completely surrounded by mountains from 8000 to 10,000 feet in elevation. Because of the high elevation combined with the northern latitude and mid-continental position, the summers are short and cool and the winters long and cold. In consequence of these climatic limitations, agricultural activities are restricted. The chief crops grown are irrigated hay and pasture grasses. As a result of these conditions, plus the fact that there are no large consuming centers near to create a fluid milk market, cheese manufacturing,

which had its beginning in 1870, has remained the leading economic pursuit of the valley. In the early period, a number of cheese plants were established in several of the small communities, but with later road improvements, better transportation, and good snow removing equipment, the number of factories has been reduced until but two of the larger ones remain. One plant receives over 80 percent of all of the milk of the valley from approximately 3500 cows.

The Use of Terracing in Philippine Agriculture. J. E. SPENCER, University of California, Los Angeles.

Abstract: Man-made terraces are common in the agricultural landscapes of the Orient. The Philippines often are used to illustrate the oriental terraced landscape, with spectacular photos which, by inference, are typical views. The terrace builders came into mountainous northern Luzon over 2000 years ago and today, making up but a small share of the Philippine population, have accumulated under 70,000 acres of highly terraced fields, less than 2 percent of the area which they occupy. These spectacular pictures, therefore, are not typical. The much larger population of other portions of the islands is descended from other peoples coming from different source areas, whose agricultural systems are the common ones found throughout the islands today, in which detailed terracing and water control are relatively unimportant items. Current expansion of the agricultural landscape is along several lines, mechanized large field patterns and primitive shifting slope culture on the colonial frontier, neither of which produce complex terraces. Increased irrigation in older settled areas is increasing productivity but not creating a highly terraced landscape. There is virtually no extension of the highly terraced landscape, which is clearly not typical of the Philippines.

The Geographical Significance of the Wheeler Surveys, 1869-1879. CHARLES F. STRONG, University of Washington.

Abstract: After the Civil War, four geographical and geological expeditions, under the command of Hayden, King, Powell, and Wheeler, for the Interior and War Departments, made extensive surveys of topography and natural resources of the Mountain West. The Geographical Survey West of the One-Hundredth Meridian, under Lieut. Geo. M. Wheeler, was charged with preparing a topographical atlas of the area to serve the army in future operations, to prepare reports on natural resources, and to study the Indians. Significant results of the expedition were:

1. The Survey provided the first detailed, systematic topographic survey and maps of 326,000 square miles of the American Southwest.
2. Over 150,000 square miles have not since been re-surveyed and covered by more recent topographic maps.
3. Land classification maps for 175,000 square miles were published, indicating arable, grazing, timbered, and arid lands.
4. The information obtained by the Survey was used by the army, settlers, General Land Office, Coast and Geodetic Survey, and the Geological Survey.
5. Data accumulated which indicated that even before extensive settlement the area was a problem area needing conservation measures respecting water and forests.
6. Provision of data for the study of the historical geography of routes of early explorers and of changing patterns of occupancy.

Marine and Stream Terraces of the Capitola-Watsonville Area, California.
CHARLES S. ALEXANDER, University of California, Berkeley.

Abstract: Three marine terraces occur along the northern shore of Monterey Bay between Santa Cruz and the Pajaro Valley. The first and third are of major size and lateral extent, continuing along the coast for at least 25 miles beyond Santa Cruz. The second terrace, about five miles in length, is confined to an area midway between Santa Cruz and the Pajaro Valley. It appears to be intimately related in space and time to the first marine terrace. All three terraces have been arched in such a manner as to indicate that uplift of the land has been steady and continuous.

With conditions of stable sea level and continuous rising land, the land will rise only at a rate greater or less than the rate of marine erosion. In either case, marine terraces will not be formed. Since terraces do occur, eustatic changes in sea level have been called upon to explain their presence.

Support for this thesis is found in the large stream valleys. The major stream valleys traversing the area are underlain by an alluvial fill at least to a depth of 150 feet. Remnants of one or more alluvial terraces are present in all the large valleys. The lowest stream terrace occurs in all valleys and is everywhere below the level of the first marine terrace. The second stream terrace can be correlated with the first marine terrace. Two higher stream terraces occur only in the valley of Corralitos Creek, a tributary of the Pajaro River. On the basis of sequence these are correlated with the second and third marine terraces.

The first stream terrace is correlated with the Cary-Mankato Interstadial period. The first marine terrace dates from a later high sea level of the Peorian Interglacial period. The second marine terrace is probably related to an earlier high sea level of the same interglacial time, and the third marine terrace dates from the Sangamon Interglacial period.

Marine Terraces in the Vicinity of Fort Ross, Sonoma County, California.
FRANCIS H. BAUER, University of California, Berkeley.

Abstract: The generally steep, terraced coast of Sonoma County, California is divided at Mill Gulch into two sectors by the San Andreas fault. Elevated marine terraces are best developed and preserved south of the Russian River. All of the three terraces represented here have a consistent, but unequal, southward inclination, indicating that following their formation they were subjected to an upward deformation whose intensity varied.

The block lying seaward of the San Andreas fault and north of Mill Gulch bears evidence of four elevated marine terraces. The lowermost is essentially undeformed, but the upper three are differentially tilted southward. This portion of the coast seemingly has been deformed by an intermittent regional uplift. A steep-sloped seven-mile section, between the Russian River and Mill Gulch, is virtually devoid of terrace remnants, a circumstance which precludes exact correlation of the terraces of the two sectors. However, tentative correlations can be made on the basis of shape and space relationships of the various terraces.

There is no evidence to indicate that there has been large-scale vertical or horizontal movement along the San Andreas fault since the initiation of the terracing cycle. It appears that this fault has served as a line of weakness across which there has been incomplete transfer of a regional deformation whose net result has been differential uplift of the entire coast. While still an active fault, it must have been considerably more

active in pre-terracing time.

The two factors which appear to be most important in controlling the formation of marine terraces along this coast are lithology and steepness of the original slopes. Along the Sonoma coast the wider, more perfect terraces are associated with the Jurassic Franciscan rocks, less resistant and more homogeneous, east of the San Andreas fault, while those formed on the varied and resistant Cretaceous sedimentaries west of the fault often exhibit narrow, broken surfaces. The relative narrowness of all of these terraces, as compared to other sections of the California coast, is explained by the steepness of slopes prevalent here.

Absolute dating for these terraces is impossible at this time. Tentatively the following correlations are advanced: The lowermost terrace, found only in the northern sector, is correlated with the Peorian interglacial period. The over-deepened valley of the Russian River, now partially filled with recent alluvium, is correlated with the maximum of the Wisconsin glaciation. The terrace which now stands at about 100 feet above present sea level, found in both sectors, is correlated with the Sangamon interglacial period.

THURSDAY EVENING SESSION, JUNE 22

Annual Dinner, Union Club, University of Utah. Address of the retiring President: "Geomorphic Landscapes." JOHN E. KESSELI, University of California, Berkeley. Published in full in this issue.

FRIDAY MORNING SESSION, JUNE 23

The New Thornthwaite Classification as Applied to the Climates of California. CLYDE P. PATTON, University of California, Berkeley.

Abstract: Thornthwaite's newest contribution to climatology is the introduction of the concept of potential evapotranspiration -- the evaporation from soil and transpiration from plants under optimum moisture conditions. The comparison of potential evapotranspiration or water need with precipitation yields a new, rational method of delimiting dry from moist climates.

Several maps of California were drawn to illustrate Thornthwaite's climatic classification of 1948. The first showed that water need (which depends on temperature alone) ranged from over 50 inches in Death Valley to less than 15 inches in the highest part of the Sierra Nevada. A second map showed the moisture index, which varies from nearly minus 60 in Death Valley to well over 250 in various parts of the northern ranges. A third map combined these two elements into a more complete classification. This showed over 30 climatic types, with particularly good differentiation of the San Joaquin and Sacramento Valleys.

A chart of several type stations, mainly along the coast and in the Central Valley, illustrated the annual cycle of water need and precipitation for those stations. These graphs emphasized the coincidence of precipitation maxima with water need minima and vice versa. With decreased water need northward, and particularly with increased water available, there is a greater surplus, and therefore run-off.

Finally, a map of run-off calculated from Thornthwaite's formulae was compared with a similar map of measured run-off. Except in the Sacramento Valley and the mountains of Southern California, the agreement was close.

The advantages of Thornthwaite's new system are several. First, it

has a large number of divisions and, therefore, shows greater local agreement. It makes possible the predicting of irrigation needs. It allows for calculating the probable water run-off, and permits these data to be checked by comparison with measured run-off. Lastly, and most importantly, in its independence from soil or plant distribution as a criterion of its boundaries, this classification is an approach towards a rational classification.

Recent Cultural Changes on the Island of Nauru, Southwest Pacific. GRAHAM H. LAWTON, University of Washington. No abstract received, but this paper was published in full in The Journal of Geography, Vol. L, Jan., 1951.

Political Divisions of Idaho. BENJAMIN E. THOMAS, University of California, Los Angeles.

Abstract: Oregon, Washington, Montana, and Wyoming were carved from the Northwest with convenient boundaries, leaving Idaho as a remnant with an awkward outline. Humid northern Idaho is mostly hilly, forested country with mining, lumbering, and wheat farming as major occupations. Central Idaho's rugged mountains are largely uninhabited. Southern Idaho is a sage brush plain where sheep herding and irrigation farming are typical activities. Strong north-south sectionalism and isolation repeatedly have caused bitter dispute over the location of the capital and over boundary changes. Railroads came to each section, but there is still no north-south line within the state. The University of Idaho, located in the north, became a subject of sectional disputes. A north and south highway was constructed, after many physical and economic difficulties, but the north-south conflict continued.

The early Idaho counties were large, and the boundaries followed such features as meridians, parallels, and major rivers -- the only known lines of division at that time. Increased population in combination with poor transportation resulted in new counties. Boundaries were gradually shifted so that many counties now show a rough correspondence to valleys. The divides are often too high or too rough for farming or lumbering and form lightly populated boundary zones between the settled valleys. The Snake River canyon has persisted as a dividing line, but the counties on each side are usually separated from each other by boundaries along divides.

The populated valleys, or counties, within a drainage basin often combine into a trade area served by a major city of the state. Six areas are used as administrative districts of the state government with headquarters in the major centers of Coeur d'Alene, Lewiston, Boise, Twin Falls, Pocatello, and Idaho Falls. Early Idaho had only two political sections, the North and the South, with political activity centered in Lewiston and Boise. But large scale irrigation after 1900 produced a third (Southeast) section, with Pocatello as the leading city. When voting occurs in the state legislature on such matters as schools, taxes, and highways the state often splits into the three sections.

The early north-south struggles, plus the general correspondence of counties to valleys, of trade areas and administrative districts to drainage basins, and of political sections to regions with unified transport and economic interests suggest that states, like nations, have a distinctive political geography of their own.

Development at Three Pacific Northwest Dams. OTIS W. FREEMAN, Eastern Washington College of Education.

Abstract: Construction of McNary and Chief Joseph dams across the Columbia River and Hungry Horse on the south fork of the Flathead River is actively in progress.

McNary Dam near Umatilla, Oregon, is a multiple purpose project which will generate power, supply water for irrigation and improve navigation. Ship locks and fish ladders are being installed. McNary Dam will irrigate 380,000 acres and develop 1,380,000 kilowatts. Construction was begun in 1947 and the dam and locks will be finished by 1952. The dam will raise the water level about 90 feet in a pool whose slack water extends nearly to Pasco, Washington.

Hungry Horse is near the southwest corner of Glacier National Park. Work began in 1948 and will be finished in 1953. The dam will stand 520 feet above bedrock, will be 2100 feet long on top and will impound a lake 27 miles long. It will be the fifth highest and fourth largest concrete dam in the world. The output of electrical energy will be 300,000 kilowatts but its greatest value will be for storage of water for downstream power developments, both present and proposed. Irrigation will be of secondary importance.

Construction was begun in 1950 on the Chief Joseph Dam near Bridgeport at the mouth of Foster Creek about 50 miles downstream from the Grand Coulee. The dam is primarily for power and will generate 1,280,000 kilowatts. Chief Joseph will be the fifth dam across the Columbia River.

FRIDAY AFTERNOON SESSION, JUNE 23

Problem Areas of the Balkans. HUEY LOUIS KOSTANICK, University of California, Los Angeles.

Abstract: The Balkans have long been the "powder keg" of the world with numerous territorial problem areas that involve each of the Balkan countries. Major foreign powers are also interested participants, principally because of the strategic intercontinental location of the region. Bases of conflict include the recent development of Balkan states, intense nationalism, strategic importance, economic value, and ethnic complexity. The relative importance of these factors changes in each specific problem area. In times of crisis, the clash over territories is intensified and, in times of alliance, claims may be temporarily dropped.

The major postwar territorial change was Rumania's cession of Bessarabia and northern Bukovina to Russia. In contrast, Italy lost her Balkan territories: the Dodecanese Islands to Greece; Saseno to Albania; the Adriatic islands Zara and Istria to Yugoslavia; and Trieste was internationalized. Yugoslavia made new postwar territorial demands for Austrian Carinthia and several border areas of Styria. Hungarian claims include border areas of northern Yugoslavia, and the Rumanian Banat and Transylvania, which form over a third of Rumania. During World War II, Rumania ceded the Dobrudja to Bulgaria.

The major problem area of the Balkans is Macedonia, with the overlapping territorial claims of Bulgaria, Yugoslavia, and Greece. Bulgaria also wants Greek Thrace as an Aegean outlet, while Greece demands the Rhodope Mountains of southern Bulgaria as a strategic frontier. Epirus is another problem area, with Greece claiming the northern Epirus area in Albania, and Albania seeking southern Epirus in Greece. Turkey has

not pressed territorial claims against Balkan countries, but does have the problem of the Straits with Russia. Ten countries -- the Balkan countries themselves, Italy, Austria, and Russia -- are directly involved in these problem areas, in addition to the indirect interest of the United States and Great Britain. Hence, in view of the international situation, Balkan problems must be viewed in their international, as well as local, significance.

Geography in the Secondary Schools of Utah. ALBERT C. ANTRIE, University of Utah.

Abstract: The most imperative thing in the state of Utah today from the standpoint of geography is the lack of people trained to teach it. Since most of our administrators themselves have had no geography since they were in the seventh grade, persistence must be maintained in pointing out to them that geography is too vital to be assigned to the athletic coach just to fill out his daily schedule. We must ourselves face the fact that the addition of geography to some curricula may be difficult in view of the dearth of personnel and student body. In some of our smaller high schools geography may never attain full status, but the vitality of geographic factors must somehow be presented in the biological and social studies. But teaching geographic factors in history is only a substitute for geographic teaching. Even in the small school, difficulties should be met, not side-stepped. An alternate program can be offered between World History and World Geography in the 10th grade. A half-year unit in political geography is possible in American Problems.

Blaine and Fremont Counties, Idaho: A Study in Comparative Tourism. HARRY H. CALDWELL, University of Idaho.

Abstract: Blaine and Fremont counties in southern Idaho represent two important tourist areas within the state. Both are located near the northern contact of the Snake River lava plain and the Rocky Mountains and are enhanced thereby with a variety of tourist resources.

Fremont County had an initially developed transient tourist function as Idaho's "gateway" county to adjacent Yellowstone National Park. Within the last 50 years the county's northern area within the Targhee National Forest has itself become an important tourist objective for summer residents, vacationists, fishermen and hunters who come mainly from southeastern Idaho, Utah and California.

Blaine County was long dominated by grazing and mining economies. Its tourist industry, until 1936, was oriented about three hot spring resorts, several summer cottages and the hope of a national park in the Sawtooth Mountains. Construction of the Sun Valley resort within the county has completely reoriented the tourist industry in the county. The hot spring areas have assumed a minor role and Sun Valley has become the fashionable center on whose periphery there have developed several parasitic industries.

Increasing numbers of national park visitors have benefited both of these counties. Blaine County is becoming increasingly popular as a visitation point because of widespread Sun Valley tourist promotion and longer vacation trips.

This paper will be published in Economic Geography.

Geography of Utah's Turkey Enterprise. H. BOWMAN HAWKES, University of Utah.

Abstract: The turkey industry in Utah has grown in the last 50 years from an incidental farm activity to a highly commercialized enterprise. During the early period of settlement the turkey flocks were small and few in number. In the decade 1920-1930 the small farm flocks were replaced by larger commercial flocks and the center of activity shifted from the Salt Lake Oasis to the sparsely settled areas where open range foraging of large flocks could be carried on. For a number of years the industry thrived but excessive foraging by the ever-increasing size of the flocks resulted in crop destruction and poorly fleshed birds. Thus the growers were forced to give up the free foraging on open ranges and they commenced to feed their flocks under semi-confinement in the more accessible areas. This change marked the beginning of the present phase of the industry's growth. From the late 1930's production rapidly increased until by 1945 there were more than a million and a half turkeys in the state.

The success of the turkey industry in Utah is the result of several factors. The relatively dry climate of Utah's mountain valleys limits the disease hazard. The decline of the sheep industry in central Utah made land, equipment, and labor accessible. The availability of cheap feed was significant in fostering the industry in the middle thirties. "Know-how" on the part of the important producers permits the industry to remain even though the margin of profit has narrowed. The role of agricultural agencies in keeping the farmer informed is of no minor importance. In central Utah the existence of a well-managed Co-op has been a dynamic factor in the growth of the enterprise. The future of the industry in Utah depends upon the maintenance and improvement of the several advantages the state enjoys.

White Acclimatization in Indonesia. FRANCES M. EARLE, University of Washington. No abstract received.

Historical Geography of the San Gorgonio Pass Area, California. JOHN THOMPSON, University of California, Berkeley. No abstract received.

Special Artificial Pits and Soils Methods in Studying the Quaternary Deposits in the Ukraine. VASYL GVOSDETSKY, University of Utah.

Abstract: The territory of Ukraine is covered by a layer of quaternary deposits measuring from 5 to 75 feet in depth. About 75 percent of the territory is covered with loess deposits. These deposits have been investigated during many years. Prior to the 1920's the investigations were carried on largely by means of natural cuttings and special borings. Since the 1920's, the soil scientists of Ukraine have introduced special artificial pits. The pits at the surface were usually made square-shaped, with the sides measuring seven to ten feet and the bottom about three to five feet. The depth of the pit varied from 10 to 30 feet, and sometimes more, depending upon local conditions. This method of using artificial pits was developed by Nabokikh, and it has enabled the soil scientist, geologist, and climatologist to study more effectively fossil soils, their genesis and climatic changes of the past as revealed in the deposits.

SATURDAY FIELD EXCURSION, JUNE 24

Field excursion along the foot of the Wasatch, to Bingham Canyon and other points of interest in the hinterland of Salt Lake City. Leader: Elbert Miller, University of Utah.

Abridged Report of the Secretary-Treasurer

May 31, 1950

As of May 31, 1950 there were 194 Association members. This was an increase of 31 over the year 1949, but of the total for the current year only 103 are paid-up members in good standing. Of the 21 student members, 9 are paid-up.

Two Newsletters were distributed during the year.

Income Deposits	
Opening Balance	$ 762.97
Royalties	13.00
Dues	367.05
Yearbook Sales	94.00
Misc. Income	12.83
Total Deposits	$1249.85

Withdrawals of Funds	
Printing Yearbook Vol. 11	$473.67
Cost of Yearbook Plates	71.78
Yearbook Distribution, not including Postage	11.56
Telegram Charges	1.66
Total Withdrawals	$558.67
Bank Balance May 31, 1950	$691.18

Officers, 1950-51

President, J. Lewis Robinson, University of British Columbia.

Vice-President, Samuel N. Dicken, University of Oregon, Eugene.

Secretary-Treasurer, Francis J. Schadegg, Eastern Washington College of Education, Cheney.

Editor, J. E. Spencer, University of California, Los Angeles.

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